Technical Specification Group Services and System Aspects
Meeting #14, Kyoto, Japan, 17-20 December 2001

TSGS#14(01)0698

Source: **TSG-SA WG4**

Title: CRs to TS 26.103 on Inclusion of codec type UMTS AMR_2 in R99 codec list (R99), and Removal of AMR-WB codec type (Release 4)

Document for: **Approval**

Agenda Item: **7.4.3**

The following CRs, agreed at the TSG-SA WG4 meeting #19, are presented to TSG SA #14 for approval.

Spec	CR	Rev	Phase	Subject	Cat	Vers	WG	Meeting	S4 doc
26.103	011		R99	Inclusion of codec type UMTS AMR_2 in R99 codec list	F	3.0.0	S4	TSG-SA WG4#19	S4-010692 (R)
26.103	010		REL-4	Removal of AMR-WB codec type	F	4.1.0	S4	TSG-SA WG4#19	S4-010629 (R)

3GPP TSG-SA4 TFO Ad-Hoc Meeting
Monschau, Germany, November 26-27, 2001

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CHANGE REQUEST

⌘ **26.103** **CR** **010** ⌘ rev **-** ⌘ Current version: **4.1.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [X] Radio Access Network [X] Core Network [X]

Title:	⌘	Removal of AMR-WB codec type
Source:	⌘	TSG SA WG4
Work item code:	⌘	AMR-WB
Date:	⌘	17-Dec-2001
Category:	⌘	**F**
Release:	⌘	REL-4

Use one of the following categories:
F *(essential correction)*
A *(corresponds to a correction in an earlier release)*
B *(Addition of feature),*
C *(Functional modification of feature)*
D *(Editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:

2	*(GSM Phase 2)*
R96	*(Release 1996)*
R97	*(Release 1997)*
R98	*(Release 1998)*
R99	*(Release 1999)*
REL-4	*(Release 4)*
REL-5	*(Release 5)*

Reason for change:	⌘	AMR-WB postponed to REL-5
Summary of change:	⌘	Removed reference to AMR-WB from specification.
Consequences if not approved:	⌘	Confusion of codecs supported in REL-4.

Clauses affected:	⌘	Sections		
Other specs affected:	⌘	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘	
Other comments:	⌘			

How to create CRs using this form:
Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.
2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://www.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2000-09 contains the specifications resulting from the September 2000 TSG meetings.
3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

4 General

The present Technical Specification outlines the 3GPP internal Codec Lists for both, GSM and UMTS, to be used by the Out of Band Transcoder Control (OoBTC) protocol to set up a call or modify a call in Transcoder Free Operation (TrFO).

It further specifies the coding of the Supported Codec List Information Elements as defined in 3GPP TS 24.008 for the UMTS radio access technology.

Transcoder Free Operation allows the transport of speech signals in the coded domain from one user equipment (UE) to the other user equipment through the radio access network (RAN) and core network (CN), possibly through a transit network (TN). This enables high speech quality, low transmission costs and high flexibility.

The necessary Codec Type selection and resource allocation are negotiated out of band **before** and after call setup. Possible Codec (re-)configuration, Rate Control and DTX signalling may be performed after call setup by additional inband signalling or a combination of inband and out-of-band signalling.

Up to release ´99 GSM does not support Transcoder Free Operation, but specifies the Tandem Free Operation (TFO). Tandem Free Operation enables similar advantages, but is based on pure inband signalling **after** call setup.
The parameters defined in this Technical Specification allow interaction between TrFO and TFO. They further provide an evolutionary path for GSM towards Transcoder Free Operation.

The GSM and UMTS standards define currently nine different Codec Types: GSM Full Rate, GSM Half Rate, GSM Enhanced Full Rate, Full Rate Adaptive Multi-Rate, Half Rate Adaptive Multi-Rate, UMTS Adaptive Multi-Rate, UMTS Adaptive Multi-Rate 2, TDMA EFR and PDC EFR. Within each radio access technology the following Codec Types may be used, see table 4.1.

Table 4.1: Support of Codec Types in Radio Access Technologies

	TDMA EFR	**UMTS AMR2**	**UMTS AMR**	**FR AMR**	**HR AMR**	**GSM EFR**	**GSM HR**	**GSM FR**
GSM	not defined	not possible	Not possible	yes (4 modes)	yes (4 modes)	yes	yes	yes
UMTS	yes	yes (8 modes)	Yes (8 modes)	yes (8 modes)	yes, but use FR AMR	yes	not defined	not defined

						~~UMTS AMR-WB~~	**~~FR AMR-WB~~**	**PDC EFR**
GSM						~~not possible~~	~~yes (4 modes)~~	not defined
UMTS						~~yes (9 modes)~~	~~yes (7 modes)~~	yes

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Tokyo, Japan, December 2-7, 2001

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CHANGE REQUEST

⌘ **26.103** **CR** **011** ⌘ rev **-** ⌘ Current version: **3.0.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM ☐ ME/UE **X** Radio Access Network **X** Core Network **X**

Title:	⌘	Inclusion of codec type UMTS AMR2 in R99 codec list
Source:	⌘	TSG SA WG4
Work item code:	⌘	AMR
Date:	⌘	17-Dec-2001
Category:	⌘	**F**
Release:	⌘	R99

Use one of the following categories:
F *(essential correction)*
A *(corresponds to a correction in an earlier release)*
B *(Addition of feature),*
C *(Functional modification of feature)*
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Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:

2	*(GSM Phase 2)*
R96	*(Release 1996)*
R97	*(Release 1997)*
R98	*(Release 1998)*
R99	*(Release 1999)*
REL-4	*(Release 4)*
REL-5	*(Release 5)*

Reason for change:	⌘	Missing definition
Summary of change:	⌘	Codec type UMTS AMR2 added to codec list, editorial changes unifying codec naming
Consequences if not approved:	⌘	Inconsistencies in R99 specifications.

Clauses affected:	⌘	Sections
Other specs affected:	⌘	☐ Other core specifications ⌘ ☐ Test specifications ☐ O&M Specifications
Other comments:	⌘	

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3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

3 Definition of the 3GPP Codec List

The GSM and UMTS standards define currently six different Codec Types: GSM Full Rate, GSM Half Rate, GSM Enhanced Full Rate, GSM Full Rate Adaptive Multi-Rate, GSM Half Rate Adaptive Multi-Rate ~~and~~, UMTS Adaptive Multi-Rate and UMTS Adaptive Multi-Rate 2.

The definition of the common Codec List in 3GPP for GSM and UMTS follows the specifications given in ITU Q.765.5: The most preferred Codec Type is listed first, followed by the second preferred one, and so on. An informative example for a codec list for UMTS can be found in Annex A.

5.1 GSM Full Rate Codec Type

The Codec IDentification (CoID) code is defined to be: FR_CoID := 0x0000.0000.

The GSM Full Rate Codec Type has no additional parameters.

For information (for exact details see GSM Recommendations):

The GSM Full Rate Codec Type supports one fixed Codec Mode with 13.0 kBit/s.

DTX may be enabled in uplink and in downlink independently of each other. DTX on or off is defined by the network on a cell basis and can not be negotiated at call setup or during the call. The DTX scheme uses one SID frame to mark the end of a speech burst and to start Comfort Noise Generation. Identical SID frames for comfort noise updates are sent in speech pauses about every 480 ms, aligned with the cell´s TDMA frame structure. The defined Tandem Free Operation allows the reception of GSM FR DTX information for the downlink direction in all cases. The TFO respectively TrFO partner is prepared to receive DTX information as well.

5.2 GSM Half Rate Codec Type

The Codec IDentification (CoID) code is defined to be: HR_CoID := 0x0000.0001.

The GSM Half Rate Codec Type has no additional parameters.

For information (for exact details see GSM Recommendations):

The GSM Half Rate Codec Type supports one fixed Codec Mode with 5.60 kBit/s.

DTX may be enabled in uplink and in downlink independently of each other. DTX on or off is defined by the network on a cell basis and can not be negotiated at call setup or during the call. The DTX scheme uses one SID frame to mark the end of a speech burst and to start Comfort Noise Generation. Identical SID frames for comfort noise updates are sent in speech pauses about every 480 ms, aligned with the cell´s TDMA frame structure. The defined Tandem Free Operation allows the reception of GSM HR DTX information for the downlink direction in all cases. The TFO respectively TrFO partner shall be prepared to receive DTX information as well.

5.3 GSM Enhanced Full Rate Codec Type

The Codec IDentification (CoID) code is defined to be: EFR_CoID := 0x0000.0010.

The GSM Enhanced Full Rate Codec Type has no additional parameters.

For information (for exact details see GSM Recommendations):

The GSM Enhanced Full Rate Codec Type supports one fixed Codec Mode with 12.2 kBit/s.

DTX may be enabled in uplink and in downlink independently of each other. DTX on or off is defined by the network on a cell basis and can not be negotiated at call setup or during the call. The DTX scheme uses one SID frame to mark the end of a speech burst and to start Comfort Noise Generation. It is important to note that the Comfort Noise parameters for this start of the comfort noise generation are calculated at transmitter side from the previous eight speech frames. A DTX hangover period needs to be applied therefore at transmitter side before sending the first SID frame. SID

frames with incremental information for comfort noise updates are sent in speech pauses about every 480 ms, aligned with the cell´s TDMA frame structure. The defined Tandem Free Operation allows the reception of GSM EFR DTX information for the downlink direction in all cases. The TFO respectively TrFO partner shall be prepared to receive DTX information as well.

5.4 ~~Three~~ Adaptive Multi-Rate Codec Types

The Adaptive Multi-Rate Codec algorithm is applied in GSM and UMTS in ~~three~~ four different Codec Types.
The Codec IDentification (CoID) codes are defined to be:
FR_AMR_CoID := 0x0000.0011.
HR_AMR_CoID := 0x0000.0100.
UMTS_AMR_CoID := 0x0000.0101.
UMTS_AMR_2_CoID := 0x0000.0110.

The AMR may have several additional parameters. These parameters are optional at originating side, but mandatory for the terminating side:
Active Codec Set, ACS: eight bits.
In FR AMR and HR AMR up to four modes may be selected by setting the corresponding bits to “1”;
In HR AMR only four out of the lower six modes can be selected;
In UMTS AMR and UMTS AMR2 up to all eight modes may be selected.
If the ACS is not specified at originating side, then all modes are supported there.
The terminating side may then select freely.
If ACS is not provided, then SCS and MACS can not be provided as well.
Supported Codec Set, SCS: eight bits.
In FR AMR ~~and~~, UMTS AMR and UMTS AMR2 up to eight modes may be selected by setting the corresponding bits to “1”.
In HR AMR only the lower six modes may be selected.
If the SCS is not specified at originating side, then all modes are supported there.
The terminating side may then select freely.
If SCS is not provided, then MACS can not be provided as well.

Maximal number of Codec Modes, MACS: three bits.
In FR AMR and HR AMR one to four Codec Modes are allowed within the ACS.
Coding: “001: one, “010”: two, “011”: three, “100”: four Codec modes allowed.
In UMTS AMR and UMTS AMR2 ~~one~~ up to eight Codec Modes are allowed within the ACS.
Coding: “001: one, “010”: two, … “111”: seven, “000” eight Codec modes allowed.
If MACS is not specified at originating side, then the maximum of modes is supported there.
The terminating side may then select freely.
Initial Codec Mode: three bits; one of the Codec Modes within the ACS is indicated as starting mode.
Coding: “000”: 4,75 kBit/s Codec Mode; … “111”: 12,2 kBit/s Codec Modes is Initial Codec Mode.
If the ICM is not specified at originating side, then the terminating side may select freely.

The Length Indicator field (LI) is set to 3, 4, 5 or 6 at originating side, depending on how many parameters are specified. The terminating side shall return the selected Codec with a full set of parameters. Hence LI shall be set to 6 always by the terminating side. If any node in the path from originating side to terminating side does not support the parameter set offered by the originating side, it may restrict it. If necessary the missing, optional parameter octets may have to be inserted then.
The ”Single Codec” information element consists of 5 to 8 octets in case of the AMR Codec Types (table 5.4):

Table 5.4: Coding of "Single Codec" for the Adaptive Multi-Rate Codec Types

Octet	Parameter	MSB 8	7	6	5	4	3	2	1 LSB
1 m	Single Codec	Single Codec (see ITU-T Q.765.5)							
2 m	Length Indication	6							
3 m	Compat. Info	Compatibility Information							
4 m	OID	3GPP ("*non-ITU-T organisation according to reference [5]*", See ITU-T Q.765.5)							
5 m	CoID	FR_AMR_CoID ~~or~~ , HR_AMR_CoID ~~or~~ , UMTS_AMR_CoID or UMTS_AMR_2_CoID							
6 o	ACS	12.2	10.2	7.95	7.40	6.70	5.90	5.15	4.75
7 o	SCS	12.2	10.2	7.95	7.40	6.70	5.90	5.15	4.75
8 o	ICM, MACS	(spare)	(spare)	ICM			MACS		

with "m" = mandatory and "o" = optional

For information on GSM procedures (for exact details see GSM Recommendations):

The GSM AMR Codec Types comprise eight (Full Rate), respectively six (Half Rate) different Codec Modes: 12,2 … 4,75 kBit/s.

The active Codec Mode is selected from the Active Codec Set (ACS) by the network (Codec Mode Command) with assistance by the mobile station (Codec Mode Request). This Codec Mode Adaptation, also termed Rate Control, can be performed every 40 ms by going one Codec Mode up or down within the ACS. The Codec Modes in uplink and downlink at one radio leg may be different. In Tandem Free Operation both radio legs (A and B) are considered for the optimal selection of the active Codec Mode in each direction (uplink A and then downlink B, respectively vice versa) by the "Distributed Rate Control" algorithm. The worst of both radio legs determines the highest allowed Codec Mode, respectively the maximally allowed rate. Besides this "Maximum Rate Control" the active Codec Mode may sometimes be frozen to a fixed mode by any of the two radio legs to allow a smooth handover procedure ("Exact Rate Control"). All rate control commands are transmitted inband: on the radio interface, the BTS-TRAU interface and the TRAU-TRAU interface.

The Active Codec Set is configured at call setup or reconfigured during the call. It consists of one up to maximally four Codec Modes (MACS) at a given time, selected from the Supported Codec Set. The maximal number of Codec Modes and the Supported Codec Set may be constrained by the network to consider resources and radio conditions.
The Active Codec Sets in uplink and downlink are identical, but may be different as well (ffs).
First, at start up of Tandem Free Operation, both Active Codec Sets are taken into account to determine the common Active Codec Set. In a later phase the Supported Codec Sets and MACSs of both radio legs may be taken into account to find the optimum Common Active Codec Set. All configuration data and update protocols are transmitted inband.

The DTX scheme of the Adaptive Multi-Rate Codec Type marks with a specific SID_FIRST frame the end of a speech burst. SID_FIRST does not contain Comfort Noise parameters. This SID_FIRST starts the comfort noise generation with parameters that are calculated at receiver side ~~(!)~~ from the latest received seven speech frames. A DTX hangover period needs to be applied therefore at transmitter side before sending of this SID_FIRST.
Absolutely coded SID_UPDATE frames follow about every eighth frame (160 ms) in speech pauses. SID_UPDATE frames are sent independently of the cell´s TDMA frame structure and are related only to the source signal.
An ONSET frame (typically) precedes in uplink direction the beginning of a new speech burst. DTX on or off is defined by the network on a cell basis. The defined Tandem Free Operation allows the reception of GSM-AMR DTX information for the downlink direction in all cases.

Note: The DTX scheme of the Enhanced Full Rate Codec Type is not compatible with the DTX scheme of the Adaptive Multi-Rate Codec Type in Codec Mode 12.2 kBit/s, although the speech modes of these two Codec Types are bit exact identical.

For information on UMTS procedures (for exact details see ~~UMTS~~Release 4 specifications TS 28.062 (TFO~~, ffs~~) and TS 23~~.x~~.~~yyy~~ 153 (TrFO~~, ffs~~):

The ~~UMTS~~ UMTS AMR Codec Type comprises eight different Codec Modes: 12,2 … 4,75 kBit/s.

The active Codec Mode is selected from the Active Codec Set (ACS) by the network. This Codec Mode Adaptation, also termed Rate Control, can be performed every 20 ms by going to any arbitrary Codec Mode within the ACS. The Codec Modes in uplink and downlink at one radio leg may be different. In Tandem Free Operation or Transcoder Free

Operation both radio legs (A and B) are considered for the optimal selection of the active Codec Mode in each direction (uplink A and then downlink B, respectively vice versa) by a “Distributed Rate Control” algorithm. The worst of both radio legs determine the highest allowed Codec Mode, respectively the maximally allowed rate. Besides this “Maximum Rate Control” the active Codec Mode may sometimes be frozen to a fixed mode by any of the two radio legs to allow a smooth handover procedure (“Exact Rate Control”). All rate control commands are transmitted inband on the IU and A interface and out of band on the radio interface ~~(ffs)~~.

The Active Codec Set is configured at call setup or reconfigured during the call. It consists of one up to maximally eight Codec Modes (MACS) at a given time, selected from the Supported Codec Set. The maximal number of Codec Modes and the Supported Codec Set may be constrained by the network to consider resources and radio conditions.
The Active Codec Sets in uplink and downlink are ~~typically~~ identical~~, but may be different as well (ffs)~~.
At call setup the Originating Side sends the AMR parameter set (included in the Codec List). The Terminating side then selects a suitable ACS from the given information and sends it back. In case the terminating side does not support TrFO a transcoder is allocated in the path at a suitable position, preferably as close as possible to the terminating side. This transcoder may by inband signalling install a Tandem Free Operation after call setup. Then, at start up of Tandem Free Operation, both Active Codec Sets are taken into account to determine the common Active Codec Set. In a later phase the Supported Codec Sets and MACSs of both radio legs may be taken into account to find the optimum Common Active Codec Set. All configuration data and update protocols are transmitted inband on the TFO interface, but (possibly) out of band within the UMTS network. For information on Tandem Free Operation see GSM 08.62 respectively TS 28.062 ~~(ffs)~~.

The SCR scheme of the default Adaptive Multi-Rate Codec Type marks with a specific SID_FIRST frame the end of a speech burst. SID_FIRST does not contain Comfort Noise parameters. This SID_FIRST starts the comfort noise generation with parameters that are calculated at receiver side (!) from the latest received seven speech frames. A DTX hangover period needs to be applied therefore at transmitter side before sending of this SID_FIRST.
Absolutely coded SID_UPDATE frames follow about every eighth frame (160 ms) in speech pauses. SID_UPDATE frames are sent independently of the cell´s timing structure and are related only to the source signal.
An ONSET frame does (typically) not exist in UMTS networks, but may be received in TFO from the distant partner. It marks the beginning of a speech burst. SCR on or off is defined by the network on a cell or call (ffs) basis. The defined Tandem Free Operation and Transcoder Free Operation allows the reception of AMR SCR information for the downlink direction in all cases.

The SCR scheme of ~~UMTS~~ UMTS AMR Codec Type is fully compatible to the DTX scheme of FR AMR and HR AMR of GSM.

UMTS AMR2 Codec Type is similar to UMTS AMR, except for rate control. An UMTS AMR2 encoder is allowed to perform codec mode change only every 2nd frame similar to GSM AMR Codec Types. On the decoder direction, an UMTS AMR2 codec can accept mode changes in every frame. Therefore this codec type is compatible (in TFO and TrFO sense) with both UMTS AMR, FR AMR and HR AMR Codec Types.

For compatibility with other systems the UMTS AMR Codec applications may optionally support various other DTX and Rate Control schemes: GSM –EFR, TDMA –EFR~~, TDMA–US1~~, PDC –EFR.

The exact details of these Codec Types and their related procedures (DTX, Rate Control, etc) are described in the respective standard documentation.

Up to release ´99 it is not possible to establish a Transcoder Free Operation between UMTS and these other systems, but it may soon be possible to establish Tandem Free Operation between UMTS and all these other systems.

Annex A (informative) : Example Codec List for UMTS

This Annex gives some informative examples how the Codec List for UMTS may look like for the BICC protocol.
UMTS does support: UMTS -AMR, UMTS AMR2, FR AMR and HR AMR. It may support also GSM –EFR, ~~TDMA–12.2,~~ TDMA –~~7.40~~EFR and PDC –~~6.70~~EFR.
One list (with arbitrarily selected Codec Type preference) could look at Originating side like:

Octet	Parameter	MSB 8	7	6	5	4	3	2	1 LSB
1	Codec List	Codec List (see ITU-T Q.765.5)							
2	Length Indication (LI)	30							
3	Compat. Info	Compatibility Information							
4	Single Codec	Single Codec (see ITU-T Q.765.5)							
5	LI	6							
6	Compat. Info	Compatibility Information							
7	OID	3GPP ("*non-ITU-T organisation according to reference [5]*", See ITU-T Q.765.5)							
8	CoID	UMTS_AMR_CoID							
9 o	ACS	12.2	10.2	7.95	7.40	6.70	5.90	5.15	4.75
10 o	SCS	12.2	10.2	7.95	7.40	6.70	5.90	5.15	4.75
11 o	MACS	(spare)	(spare)	ICM			MACS		
12	Single Codec	Single Codec (see ITU-T Q.765.5)							
13	LI	6							
14	Compat. Info	Compatibility Information							
15	OID	3GPP ("*non-ITU-T organisation according to reference [5]*", See ITU-T Q.765.5)							
16	CoID	FR_AMR_CoID							
17 o	ACS	12.2	10.2	7.95	7.40	6.70	5.90	5.15	4.75
18 o	SCS	12.2	10.2	7.95	7.40	6.70	5.90	5.15	4.75
19 o	MACS	(spare)	(spare)	ICM			MACS		
20	Single Codec	Single Codec (see ITU-T Q.765.5)							
21	LI	6							
22	Compat. Info	Compatibility Information							
23	OID	3GPP ("*non-ITU-T organisation according to reference [5]*", See ITU-T Q.765.5)							
24	CoID	HR_AMR_CoID							
25 o	ACS	(spare)	(spare)	7.95	7.40	6.70	5.90	5.15	4.75
26 o	SCS	(spare)	(spare)	7.95	7.40	6.70	5.90	5.15	4.75
27 o	MACS	(spare)	(spare)	ICM			MACS		
28	Single Codec	Single Codec (see ITU-T Q.765.5)							
29	LI	3							
30	Compat. Info	Compatibility Information							
31	OID	3GPP ("*non-ITU-T organisation according to reference [5]*", See ITU-T Q.765.5)							
32	CoID	EFR_CoID							

with "o" = optional octet

The Terminating Side selects one of the Codec Types and returns it, together with the selected codec attributes.

The ~~three~~ AMR Codec Types may have very similar, if not identical codec attributes at Originating side. The UMTS as Originating side can, however, already decide, which configuration would be preferred in case the Terminating side is UMTS, or GSM FR or GSM HR. A GSM as Originating side can not offer UMTS~~–~~ AMR or UMTS AMR2 and the Codec attributes for FR AMR and HR AMR may be quite different.